UNIVERSITI PUTRA MALAYSIA

WEED CONTROL IN DIRECT SEEDED RICE USING SELECTED HERBICIDES

AZMI BIN MAN

It is hereby certified that we have read this thesis entitled "Weed Control in Direct Seeded Rice Using Selected Herbicides" by Azmi Bin Man, and in our opinion it is satisfactory in terms of scope, quality and presentation as partial fulfilment of the requirements for the degree of Master of Science.

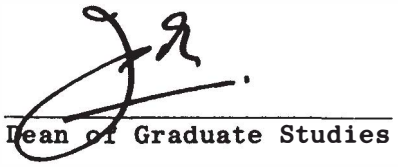
ALANG P. ZAINUDDIN, Ph. D.
Assoc. Professor/Dean of Graduate Studies
Universiti Pertanian Malaysia
(Chairman Board of Examiners)

VICTOR E. GREEN, Jr., Ph.D.
Professor (Agronomist)
Institute of Food and Agricultural Sciences
University of Florida
USA
(External Examiner)

THOHIRAH LEE BTE ABDULLAH, M.S.
Lecturer
Faculty of Agriculture
Universiti Pertanian Malaysia
(Internal Examiner)

LIM ENG SIONG, Ph.D.
Associate Professor
Faculty of Agriculture
Universiti Pertanian Malaysia
(Internal Examiner & Supervisor)

This thesis was submitted to the Senate of Universiti Pertanian Malaysia and was accepted as partial fulfilment of the requirements for the degree of Master of Science.



Date: Dean of Graduate Studies

WEED CONTROL IN DIRECT SEEDED RICE USING SELECTED HERBICIDES

by

A Z M I B I N M A N

A thesis submitted in partial fulfilment
of the requirements for the degree of
Master of Agricultural Science in the
Universiti Pertanian Malaysia
Serdang, Selangor.

December 1984

DEDICATION

I should like to dedicate this work to my wonderful wife Normah bt. Talib for encouragement and help during the preparation of this thesis and to my daughters Nor Rumaizah and Nor Diyana.

ACKNOWLEDGEMENTS

I am deeply indebted to my supervisors Professor Madya Dr. Lim Eng Siong and Encik Sabudin Mohd. Ali (until March 1984) for their constant advice and guidance during the course of my research and for their invaluable criticisms of the thesis.

Dr. Victor E. Green, Jr., CPAg., University of Florida, USA, kindly acted as external examiner of this thesis.

I would like to express my sincere thanks to Malaysian Agriculture Research and Development Institute (MARDI) for granting me study leave and scholarship without which this study would not be possible. I also express my thanks to Dr. Hj. Supaad bin Hj. Mohd. Amin (Timbalan Pengarah, Bahagian Penyelidikan Padi, MARDI) for allowing me to use field facilities at Rice Research Centre, Bumbumg Lima, Seberang Perai where most of the research was carried out. Thanks are also due to En. Cheong Ah Hwa (Agronomy section) and En. Yap Beng Ho (Statistic section) of the rice branch for helpful planning of the experiments conducted during the course of my research. The assistance of En. Mohamad Mat Daud (Senior Laboratory Assistent, U.P.M.), En. Shaharudin Shaari, Puan Rosni Ismail and En. Wan Roslan bin Wan Shaari of Rice Branch, Bumbumg Lima is gratefully acknowledge. I would also express my sincere thanks to Puan Rahimah bte. Hj. Abdullah for typing this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

An abstract of the thesis presented to the Senate of Universiti Pertanian Malaysia in partial fulfilment of the requirements for the Degree of Master of Agricultural Science.

WEED CONTROL IN DIRECT SEEDED RICE

USING SELECTED HERBICIDES

by

Azmi Bin Man

Supervisor : Professor Madya Dr. Lim Eng Siong

Co-Supervisor : En. Sabudin Bin Md. Ali

Faculty : Agriculture

Selected herbicides for the control of weeds in direct seeded rice were studied. The phytotoxicity of the herbicides, 2,4-D amine, 2,4-DIBE-butachlor, butachlor, benthiocarb and molinate were evaluated in two studies using petri dishes and plastic pots. A field study was also carried out to determine the efficacy of weed control of 2,4-DIBE-butachlor, butachlor and molinate.

2,4-D amine and benthiocarb were found to be highly phytotoxic when applied as a preemergent and as an early post-emergent. Molinate was safe to apply as a preemergent. All the herbicides evaluated were more toxic when applied during the early postemergent period 14 days after sowing than when applied later at 35 days after sowing.

It was found that the major weed problem in direct seeded rice fields was Echinochloa crusgalli (Linn.) P. Beauv. The most effective herbicide for its control was molinate. Application of this herbicide at rate 3.3 kg a.i./ha either seven days before sowing or fourteen days after sowing was effective.

An increase in yield in the range of 59 to 107 percent over unweeded plots was obtained with the use of molinate for weed control. For the additional expenditure on the herbicide application, a six-fold return was obtained.

Abstrak tesis yang diserahkan kepada Senate Universiti Pertanian Malaysia sebagai memenuhi sebahagian dari keperluan-keperluan untuk Ijazah Sarjana Sains Pertanian.

WEED CONTROL IN DIRECT SEEDED RICE

USING SELECTED HERBICIDES

Oleh

Azmi Bin Man

Ketua Penyelia : Profesor Madya Dr. Lim Eng Siong

Penyelia : En. Sabudin Bin Md. Ali

Fakulti : Pertanian

Beberapa racun herba dipilih untuk kajian kawalan rumpai pada tanaman padi tabur terus. Fitotoksisiti racun-racun herba, 2,4-D amine, 2,4-DIBE-butachlor, butachlor, benthiocarb dan molinate diselidiki dalam dua kajian menggunakan petri dish dan pasu. Suatu kajian di sawah untuk menentukan keupayaan kawalan rumpai oleh 2,4-DIBE-butachlor, butachlor dan molinate juga dijalankan.

2,4-D amine dan benthiocarb didapati sangat fitotoksik bila digunakan sebagai pra-cambah dan awal lepas-cambah. Molinate adalah selamat digunakan sebagai pra-cambah. Kesemua racun-racun herba yang dikaji adalah lebih toksik bila diberikan awal lepas-cambah 14 hari selepas tabur dari bila diberikan lewat pada 35 hari selepas tabur.

Rumpai yang penting didapati pada tanaman tabur terus ialah Echinochloa crusgalli (Linn.) P. Beauv. Racun herba yang sangat berkesan mengawalnya ialah molinate. Masa pemakaiannya pada kadar 3.3 kg b.a./ha ialah tujuh hari sebelum tabur atau empat belas hari selepas tabur.

Pertambahan hasil di antara 59 ke 107 peratus ke atas petak tanpa kawalan rumpai telah didapati dengan penggunaan molinate. Untuk tambahan perbelanjaan ke atas pemakaian racun herba, pulangan sebanyak enam kali ganda telah diperolehi.

CHAPTER I

INTRODUCTION

In Peninsular Malaysia, rice is generally transplanted. Direct seeding of rice has only recently been introduced. The total hectarage of direct seeded rice crops is still relatively small compared to that planted by the conventional transplanting method (Table 1). Currently about 10,000 hectares of rice are direct seeded. This figure represents only 5 per cent of the total rice area. However, direct seeding of rice offers many advantages over transplanted rice and is expected to be widely adopted. The benefits of direct seeding over transplanting include ease of planting and reduced labour requirements, earlier maturity of 10 to 15 days and higher yields of as much as 66 percent more (IRCN, 1981).

TABLE I. HECTARAGE OF MAJOR RICE GROWING AREAS IN PENINSULAR MALAYSIA (BAKI, 1982b).

Region	Total Area Cultivated (Hectare)	Area Under Direct Seeding (Hectare)
Tanjong Karang	18,000	2,000 - 2,400
Kerian	23,600	0
Seberang Perak	9,090	400 - 440
Pulau Pinang	12,800	80 - 120
Muda Area	94,800	6,000 - 6,400
Kemubu Area	32,400	0

In spite of the advantages of direct seeding, a major problem in a direct seeded rice crop is weed control. In direct seeding, the rice seeds germinate at the same time as the weed seeds and it is difficult to carry out manual weeding. In transplanted rice there is a competitive advantage over weeds at the time of planting and weeding is easy due to the systematic plant arrangement.

In direct seeded rice, due to the problems associated with manual weeding of the crop it appears that the use of herbicide may be the solution to the weed control problem. In Malaysia, phenoxy herbicides (e.g. 2,4-D) have been widely used by farmers for the control of broadleaf weeds flooded rice (Saharan, 1977). However, with direct seeding of rice, the weeds generally encountered are grasses because the field is not flooded during seeding. Therefore, herbicides suitable for the control of such grass weeds are necessary. Recently several promising herbicides for the control of various weeds have been introduced into the country. However, these have yet to be evaluated for their effectiveness in direct seeded rice crops locally. Hence, the present study was conducted with the following objectives :-

1. To determine the phytotoxic effect of selected herbicides on rice plants.
2. To determine the optimum time for the application of selected herbicides.
3. To determine the effectiveness of selected herbicides for the control of major weeds in a direct seeded rice crop.

CHAPTER III

LITERATURE REVIEW

Weed Species in Flooded Rice Growing Areas of Malaysia

In flooded rice fields the weeds encountered may be classified into broadleaves, sedges, grasses and aquatic plants. In Peninsular Malaysia, a conglomeration of 78 species belonging to 38 genera in 28 families was recorded in five main rice growing areas as shown in Table II (MARDI Ann. Rep. 1982). These species may be subdivided into annual and perennial weeds. The annuals include 5 grasses, 21 sedges and 22 broadleaves. The perennials consist of 12 grasses, 12 sedges and 6 broadleaves. However, only 36 of these species were considered important. They formed about 94 to 96 per cent of the total weeds present in the areas studied.

TABLE II. WEED SPECIES IN THE MAIN RICE GROWING AREAS OF PENINSULAR MALAYSIA (TANJONG KARANG, KERIAN, PULAU PINANG, MUDA AREA AND KEMUBU AREA) (MARDI ANN. REP. 1982)

Family	Species	Life Cycle[a]
Gramineae	*Brachiaria mutica* (Forssks.) Stapf	P
	B. milliformis (Presl.) C.E. Hubb	P
	Echinochloa crusgalli (L.) Beauv	A
	E. colonum (L.) Link	A
	E. cruspavonis (H.B.K.) Shult	A
	Eragrostis atrovirens (Desf.) Trin. ex Steud	P
	E. anabilis (L.) P. Beauv	A
	Isachne globosa (Thumb) O. Ktze	A
	Ischaemum indicum (Houtt) Merrill	P
	I. muticum L.	P

TABLE II. CONTINUED

Family	Species	Life Cycle[a]
Gramineae	*Leersia hexandra* swartz	P
	Oryza spp	A
	Panicum amplexicaule (Rudge) Nees	P
	P. auricum Ridll	P
	P. repens L.	P
	P. sarmentosum Roxb	P
	Paspalum conjugatum Berg	P
	P. vaginatum Swartz	P
	P. commersonii Sensu Ridl	P
Cyperaceae	*Cyperus aromaticus* (Ridley) Mattf. Kukenth	A
	C. babakan L.	P
	C. compressus L.	A
	C. diffusus Vahl.	A
	C. distans L.	P
	C. digitatus Roxb	P
	C. esculentus L.	P
	C. ferax (L.) Rich	P
	C. haspans L.	P
	C. iria L.	A
	C. luzule (L.) Retx	A
	C. odoratus L.	P
	C. malacensis L.	P
	C. pilosus (L.) Vahl	P
	C. rotundus L.	P
	Eleocharis cruspavonis L.	P
	E. chaetaria (R.Br.) Roem & Schultes	A
	E, geniculata (L.) R & R	A

TABLE II. CONTINUED

Family	Species	Life Cycle[a]
Cyperaceae	*E. retroflexa* (R.Br.) Kunth	A
	Fimbristylis acuminata Vahl	A
	F. dichotoma (L.) Vahl	A
	F. diphyla L.	A
	F. globulosa (Retz) kunth	A
	F. milliacea (L.) Vahl	A
	F. retroflexa (L.)	A
	F. schnoides Vahl	A
	Fiurena umbellata Rottb.	A
	Rhynchospora corymbosa (L.) Britt	P
	Scirpus grossus (L.)	P
	S. juncoides (L.) Roxb	A
	S. laterifolius (L.) Gmel	A
	S. mucronatus L.	A
Onagraceae	*Jussea linifolia* Vahl	A
	J. repens	A
	J. suffructicosa Nutt	A
Pontederaceae	*Monochoria elata* Ridl	A
	M. vaginalis (Burm.f.) Presl	A
Marsileaceae	*Marsilea crenata* Presl	A
Salviniaceae	*Salvinia auriculata* Aublet	A
Scophulo-riaceae	*Lindernia pendunculata* Linn	A
	Limnophilla heterophylla Berth	A
Lentubula-riaceae	*Ultricularia flexuosa* Vahl	P

TABLE II. CONTINUED

Family	Species	Life Cycle[a]
Butomaceae	*Limnocharis flava* Buch	A
Alistamaceae	*Sagittaria guyanensis* Humb	A
Convolvulaceae	*Ipoemea aquatica* L.	A
Rubiaceae	*Oldelandia dichotoma* (L.) Roxb.	A
Nymphaceae	*Nymphe lotus* L.	P
	Nymphoides humboldtianum (H.B.K.) Kuntze	P
Companulaceae	*Sphenoclea zeylanica* Gaertn	A
Lemnaceae	*Lemna minor* L.	A
Ceratophyllaceae	*Ceratophyllum demersum* L.	A
Amaranthaceae	*Alternanthera triandra* Lank	P
Azollaceae	*Azolla pinnata* R.Br.	A
Xyridaceae	*Xyris pauciflora* Keohne	A
Lythraceae	*Rotala indica* Keohne	A
Hydrocharitaceae	*Blyxa malayana* Ridl	A
	Hydrilla verticillata Presl.	A
Parkeriaceae	*Ceratopteris pteridoides* (Hook) Hieron	A

[a] P - perennial A - annual

Crop Losses Due To Weeds

Weeds compete with rice directly for light, nutrients and soil moisture. Indirectly, weeds cause the lowering of water and soil temperature, harbour disease pathogens and insect pests and cause other environmental disturbances such as blockage of irrigation canals and water pollution (Kusanagi, 1981).

Infestation by weeds, besides reducing yield and grain quality also increase the cost of pest control, harvesting, drying and cleaning operations (Chang, 1965; De Datta *et al.*, 1968; Anwar, 1978). Various values have been reported from different countries on the loss of rice yield due to weeds. Okafor and De Datta (1974) reported grain yield losses due to weeds alone in upland rice in the range of 83 to 100 per cent. In Asia, the annual rice crop losses due to weeds were estimated to be 11.8 per cent of the potential production (De Datta, 1981); in India, the yield losses were estimated to 10 per cent (Bharwaj and Verma, 1969); U.S.A. around 15 per cent (Smith *et al.*, 1977) and the corresponding figure for the world is 9.5 per cent (De Datta, 1981).

The reduction of rice yield due to weeds is more severe in direct seeded than transplanted rice. In Taiwan, Chiang and Leu (1981) reported that weed competition resulted in mean yield loss of 16 per cent for transplanted rice and 62 per cent for direct seeded rice. The estimated yield reduction in Korea was 20.8 per cent for transplanted and 40 per cent for direct seeded rice (Kil, 1981). The percentage of yield reduction in transplanted rice in Malaysia